strangulatum, Philonotis Muehlenbergii, Bryum Ontariense, Fabronia octoblepharis, Thelia asprella, Leskea Austini, Anomodon rostratus, A. attenuatus A. obtusifolius, Pylaisia intricata, Cylindrothecium cladorrhizans, C. seductrix, C. compressum, Brachythecium laetum, B. acuminatum, Rhynchostegium serrulatum, Amblystegium varium, A. adnatum, Hypnum hispidulum, H. chrysophyllum.

The following species belong to the flora of the southern states (Texas Louisiana, etc.) and reach here their extreme limit northward: Archidium Hallii, Desmatodon plinthobius ?, Barbula caespitosa, Physcomitrium turbinatum ?, Bartramia radicalis, Atrichum xanthopelma.

Grimmia calyptrata and Coscinodon Wrightii seem more especially peculiar to the flora of the Rocky Mountains. Trichostomum crispulum and Pleuridium Bolanderi ? were hitherto only recorded from California.

Monaco, and *Stenay*, *France*.

Noteworthy anatomical and physiological researches.

Ovular structure of Casuarina suberosa.[1]

In this work of Treub's we have a very good example of the sensational in plant morphology. The word is not at all to be taken in a bad sense but fitly describes the altogether unsuspected results which have followed this careful investigator's examination of a group of plants of acknowledged difficulty. After discussing the insertion of the ovules and their curious displacements which have caused much discussion (see on this Baillon, Eichler, Miquel and Engler), Treub takes up the ovular structure with the following conclusions:

1. Certain large sub-epidermal cells in the young ovule are an archesporium and develop the macrospores (embryo-sacs). They lie at the summit of the nucellus and undergo a series of tangential segmentations, finally producing a thick cylinder of sporogenous tissue which, surrounded by the tapetal layer, occupies a central position in the nucellus.

2. The cells of the sporogenous layer develop tetrads of spores, of which three become absorbed, in some cases, but in

[1] Treub: Sur les Casuarinèes et leur place dans le system natural. Ann. Jard. Buitenz. x. 145–231.

others may be seen to form tracheids which are thus analogous to the elater cells of Hepaticæ The latter condition is the one observed in *Casuarina glauca* and *C. Rumphiana.*

3. Twenty macrospores are found and these elongate in the plane of the greater axis of the nucellus.

4. The micropylar ends of the macrospores develop two or three small cells which are to be considered as homologous with the canal-cells of the Eu-archegoniata and not as synergidæ. Generally only one of the macrospores has these cells endowed with a cellulose wall and this cell is the future embryo-sac.

5. The pollen tube divides, after reaching a nucellus, into at least two branches—thus reminding one of the well known phenomena in Taxus, Juniperus and Salisburia where one pollen tube is employed for the fertilization of several egg-organs.

6. A large number of endosperm nuclei are formed before the embryo is developed, thus indicating again the similarity of these cytogenetic sequences to those of the Gymnospermæ (Archispermæ).

7. Casuarina is therefore believed to occupy a decidedly anomalous position among the Metaspermæ (Angiospermæ). It is nearer to the Archispermæ than any form yet examined and may be given a place apart from the rest of the higher seed-plants. Treub proposes the following classification to admit Casuarina to its proper place, as indicated by his researches:

Archispermæ. . . . . .

Metaspermæ { Chalazagameæ :: Casuarina.
Porogameæ :: { Dicotyledoneæ.
Monocotyledoneæ.

Casuarina, the only genus of its family, contains about 30 species. They are of limited range, being found principally in Australasia. A very good account of them may be found in Grisebach's *Vegetation der Erde*, and in Engler's *Natürliche Pflanzenfamilien* there is a fair figure showing their remarkable habit of growth—so similiar to that of Equisetum that they were originally classed with that genus. They are characteristic plants in the Australian forests and with their vegetative and distributional features taken into account, it is not inherently improbable that the singularly isolated position as-

cribed to them by Treub is a correct one. Their future examination is likely to be productive of much interest.—CONWAY MACMILLAN.

A contribution to the knowledge of nuclear mechanics in the sexual and other reproductive cells of plants.[2]

The paper of Guignard here noted is remarkable not only for the brilliant series of researches which it chronicles but also for the able review of a mass of literature which is not yet very well known to any except a small coterie of specialists. Reference is made to the memoirs on the subject of the intimate phenomena which are now known to go on in both plant and animal cells in process of division, and have been called the spermatokinetic and ookinetic processes. Guignard gives a résumé of the important conclusions which have been reached in both the plant and animal world and adds some luminous suggestions concerning the physical basis of heredity. A number of the facts brought forward in this paper are not altogether new, having before appeared in recent works of the same author, but the generalizations and many of the illustrative examples are not hitherto published. Guignard has been studying the development of pollen and embryo-sacs—particularly in *Lilium martagon*—and has followed out in great detail the complicated and yet altogether orderly nuclear phenomena which invariably accompany the act of reproduction and are part of its very essence. Without the aid of any very extraordinary technique or the necessity of unusually difficult manipulations he has contributed a number of extremely interesting observations along his line of work. Some of these may be briefly noted.

1. Just outside the nuclear membrane in all cells examined there are to be distinguished two small spheres of protoplasm —called by their discoverer "directive spheres." They are not easily stained by ordinary methods. These two spheres lie side by side in the resting nucleus but when the nucleus begins to divide they are seen to have a special position and function to perform. They separate and pass to opposite ends of the nucleus and form the astrocenters towards which the chromosomes slowly move and accomplish the division of

[2]Guignard: Nouv. études sur la fécondation, Ann. Sci. Nat. Botan., Ser. VII. XIV. pp. 163—288.